

Amendments to the Claims

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

Claim 1 (Original): A frequency control apparatus comprising:

a frequency converter for receiving a signal of a first frequency modulated with a symbol representing digital information and for mixing the received signal with a second frequency different from the first frequency to convert the first frequency to a third frequency lower than the first frequency;

an oscillator for oscillating the second frequency, said oscillator being controlled to generate the second frequency in response to a control signal generated on a basis of an output of said frequency converter;

a data converter for restoring the symbol supplied from said frequency converter in conformity with modulation by which the symbol is modulated to output restored data;

a phase error operator for measuring the restored data to obtain an in-phase component and a quadrature component to the in-phase component, and using the components obtained to calculate a first phase error and a second phase error for the received signal;

an adder for summing the first and second phase errors;

a first multiplier for multiplying an output of said adder with a first coefficient; and

an integrator for integrating results of said first multiplier to generate the control signal.

Claim 2 (Original): The apparatus in accordance with claim 1, wherein said data converter comprises:

a first data converter for restoring the symbol supplied from said frequency converter in conformity with the modulation by which the symbol is modulated; and

a second data converter for delaying the symbol supplied from said frequency converter and for restoring the symbol in conformity with the modulation by which the delayed symbol is modulated.

Claim 3 (Original): The apparatus in accordance with claim 2, wherein said second data converter delays the supplied symbol by one-half symbol interval of the supplied symbol.

Claim 4 (Original): The apparatus in accordance with claim 2, wherein said phase error operator comprises:

a first phase error operator for measuring two component signals obtained at one symbol interval of the restored data, and for using the two component signals to calculate a first phase error for the received signal; and

a second phase error operator for measuring the two component signals and

delayed two component signals and for using the two component signals and the delayed two component signals to calculate a second phase error for the received signal.

Claim 5 (Currently Amended): The apparatus in accordance claim 3, wherein said phase error ~~calculator~~ operator comprises:

a first phase error operator for measuring two component signals obtained at one symbol interval of the restored data, and for using the two component signals to calculate a first phase error for the received signal; and

a second phase error operator for measuring the two component signals and delayed two component signals and for using the two component signals and the delayed two component signals to calculate a second phase error for the received signal.

Claim 6 (Original): The apparatus in accordance with claim 1, wherein said data converter restores the supplied symbol in conformity with the modulation by which the symbol is modulated at a plurality of timings at which the symbols are available.

Claim 7 (Original): The apparatus in accordance with claim 5, wherein said data converter restores the supplied symbol in conformity with the modulation by which the symbol is modulated at a plurality of timings at which the symbols are available.

Claim 8 (Currently Amended): The apparatus in accordance with claim 1 ~~[[6]]~~, wherein said phase error operator comprises:

a ~~[[third]]~~ first phase error operator for calculating the first phase error based on two pieces of phase information different by one symbol interval for the restored data; and

a ~~fourth~~ second phase error operator for calculating the second phase error based on two pieces of phase information different by one-half symbol interval for the restored data.

Claim 9 (Canceled)

Claim 10 (Original): The apparatus in accordance with claim 8, further comprising a second multiplier for multiplying the second phase error with a second coefficient for the second phase error to route a result from multiplication to said adder.

Claim 11 (Canceled)